



EXHIBIT
NO. 10
OF THE

2 A

EXHIBIT
NO. 10

EXHIBIT
NO. 10

AN EXPERIMENTAL AND CLINICAL INQUIRY INTO THE
ETIOLOGY AND DISTINCTIVE PECULIARITIES
OF TRAUMATIC FEVER.

26

BY

B. A. WATSON, M.D.,

NEW JERSEY.



EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION, 1881.

PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1881.

AN EXPERIMENTAL AND CLINICAL INQUIRY INTO THE
ETIOLOGY AND DISTINCTIVE PECULIARITIES
OF TRAUMATIC FEVER.

BY

B. A. WATSON, M.D.,

NEW JERSEY.

EXTRACTED FROM THE
TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION, 1881.

PHILADELPHIA:
COLLINS, PRINTER, 705 JAYNE STREET.
1881.

AN EXPERIMENTAL AND CLINICAL INQUIRY INTO THE ETIOLOGY AND DISTINCTIVE PECULIARITIES OF TRAUMATIC FEVER.

PROF. BILLROTH says:¹ “I am firmly of the opinion *that wound fever, and inflammatory fever generally, chiefly depend upon a poisoned condition of the blood, and that they can be produced by different materials which escape from an inflamed part into the blood.*” This distinguished author, as if to render more emphatic the same idea, employs, on another page, the following language:² “If a wounded man gets fever I conclude, whether the wound stink or not, that a phlogistic tissue-decomposition is taking place, and its products have entered his blood.” The idea here expressed is a deduction drawn principally from experiments made on animals by Billroth, which consisted in introducing into the cellular tissue beneath the integument, or directly into the veins, pus, ichor, and various putrefying organic fluids, which invariably excited local inflammation, fever, and other constitutional disturbances. A similar series of experiments were made on animals by C. O. Weber with like results. These experiments were made with fluids taken from inflamed and suppurating wounds, which freely communicated with the air, and in which, according to our present opinion, there was already going on decomposition, and which, therefore, contained septic germs. Prof. Ernst Wagner merely reiterates the opinion expressed by both Billroth and Weber when he says:³ “It is absolutely established that the mode of injury and its immediate consequences, as far as effects upon the tissues are concerned, do not by themselves constitute factors capable of explaining the states of the temperature referred to above. . . . All the remaining phenomena of traumatic fever in man are best explained by the hy-

¹ Lectures on Surgical Pathology and Therapeutics, vol. i. p. 125.

² Ibid., p. 123. ³ General Pathology, p. 672. New York, 1876.

pothesis, that it is dependent upon inflammations set up, not by the injury itself, but by septic processes taking their start in the wound. It is most probable that the fever is caused only by spores which enter the blood through the wound, and that SEPSIS is the result of vibronic putrefaction." The idea so concisely expressed in the above has already been the subject of much initial thought and dissent among surgeons more than one hundred years. During this period many surgeons have earnestly contended that the cause of inflammation and suppuration in wounds was due to atmospheric influences, while a very ancient idea attributed nearly all the evils arising in connection with a traumatism to the pseudo-demon cold. The numerous and ever-changing views of the etiology of traumatic fever, which have been promulgated in the different centuries, beginning with Hippocrates and coming down to our time, reflect for each age the true condition of the medical and other allied sciences; but it is sufficient for our purpose to state, that nearly all these theories may be classified as the septic, nervous, and nervo-septic. The question, however, here entitled to priority is, *what do we understand by traumatic fever?* Richmond says: "Traumatic fever is an inseparable companion from all wounds of a certain extent healing by suppuration." Dupuytren says: "Traumatic fever is a diseased condition following the receipt of a more or less severe wound, which has for its object the preparation of the wound for healing." C. O. Weber defines traumatic fever as a general increase of metamorphosis of the various substances of the body, accompanied by an elevation of temperature, which is caused by poisoning the blood with the products of the decomposed tissues, which act as a ferment and produce a rapid loss of body-weight. M. Verneuil declares that traumatic fever is a constitutional disease, accidentally caused by the introduction of traumatic virus, and he designates it "traumatic septicæmia." He adds that, in consequence of the small quantity of virus absorbed and the rapid elimination of the same, in some cases the disease is very slight and fugitive.

This is what happens in simple traumatic fevers; it is a diminutive characteristic manifestation of septicæmia. The definitions already cited form only a minor part of those which have been published, but the others differ from these principally in the language chosen to express the author's views rather than in the subject matter. A majority of these definitions are in-

tended to convey the etiological idea of the disease, but granting to them correctness in this particular, then it must be admitted that the use of the term *traumatic* instead of *septic* is certainly to be regarded as unfortunate, especially since many severe traumas are not attended with fever. Another objection to these definitions is found in the fact that recent observations and investigations in connection with the practice of antiseptic surgery render it exceedingly probable that there is frequently developed in connection with a wound a fever which differs in nearly all the essential characteristics from that arising from septic absorption. The attention of surgeons was first called to this subject by Genzmer and Volkmann, in an article entitled¹ "UEBER SEPTISCHES UND ASEPTISCHES WUNDFIEBER." The authors of this paper have carefully pointed out the clinical peculiarities of each morbid condition. They remark that the most important manifestation of the septic traumatic fever is produced on the nerve centres by the toxic action of the absorbed material. We must admit that there result from it exclusively, or at least principally, the general feeling of illness, the diminished sensibility which we see increasing in severe cases of septicæmia to the point of sopor, the somnolence or apathy in other cases, the unfitness for mental efforts, the hallucinations, the formal sort of intoxication which occasionally causes the prostration of strength which may increase in severe cases of this fever until extreme weakness has been produced, and more or less directly derangement of the secretory functions, and also of the digestive apparatus on which depends the slight inclination for food as a most important clinical symptom. They now add, that *all these symptoms are wanting when a patient is suffering from the purely non-septic form of the disease; which in the former instance convince him that he is sick.* The increased temperature is almost the only, certainly the *only* important, clinical symptom. Patients with a temperature of 102° to 104° , and even higher, go about, amuse themselves, are talkative and merry, smoke and play cards. Children with a similar temperature are found playing, while women and girls sit up in bed, and engage in sewing and knitting. A patient with both arms amputated, who was treated by Lister's method, and whose wounds healed by first intention, walked all over the house on the day after the operation, and continued to do the same subsequently, with an axillary tempe-

rature of 104° , amused every one about him, sang songs, and finally left the house and played buffoon. Another patient who had received a severe compound fracture of the leg, besides an extensive contusion of the soft parts with loosening of the skin, which extended from the knee to the malleoli, and who showed an axillary temperature of 105.8° , did not exhibit the slightest trace of illness, and although allowed the richest hospital diet was not really satisfied. Incisions, varying in length from two to three inches, were made at the first dressing, and afterwards the wound was thoroughly disinfected and proper drainage established. These cases show the marked clinical difference in the constitutional symptoms of *septic* and *non-septic* fever arising in connection with wounds. The examination of a *non-septic* wound cannot fail in this connection to be interesting and instructive, since every surgeon will readily contrast the symptoms found here with those which prevail in wounds where the antiseptic precautions have not been observed. The non-septic wound is characterized by this complete absence of putrefactive odors, inflammatory reaction, local heat, redness, or œdema. The wound secretion after the first forty-eight hours is either entirely wanting, or else very slight, and it is found on examination to be chiefly serous or mucous, although it may contain a few pus globules. The absorption of this discharge is entirely harmless, as has been frequently shown by the accidental displacement or occlusion of the drainage tube, thus causing the retention of this fluid in the wound frequently for several days at a time. Even in these cases no inflammatory reaction follows, neither are the lymph glands swollen, and the only harm done to the patient arises from the mechanical separation of the parts, which must delay or even prevent union by first intention. Analogous to the facts mentioned above are the changes that take place in cases of simple fractures and severely contused wounds, when the injury is done to the cellular, adipose, and muscular tissues without destroying any portion of the integument. In these cases more or less of the tissues undergo a *non-putrefactive decomposition* which is followed by a perfectly harmless absorption of their products. The circulation is destroyed in considerable portions of the various tissues, even including the osseous, in cases of simple fractures, and nature has provided this instructive and harmless method for their removal. The medical profession is already so familiar with putrefactive decomposi-

tion, and its resulting septic absorption and blood poisoning, with its grave symptoms and frequent fatal termination, that it is wholly unnecessary here to furnish details in order to enable a comparison to be made between it and the *non-putrefactive decomposition*.

It is a well demonstrated fact that the former arises in putrescible substances which have been in some way exposed to contamination, most frequently by being open to the air; while in the latter case, although the material may be the same, the exposure and contamination have been avoided. We, therefore, observe putrefactive decomposition, septic absorption, and septic fever in the wounds which are open to the air; but in those wounds which are purely subcutaneous, or, if open, where the antiseptic method of treatment has been successfully applied, there is found *only the non-putrefactive decomposition*, harmless absorption, and a non-septic fever, which has neither pathological nor prognostic signification. Our inquiry brings before us two varieties of fever: one of unquestionable septic origin, whilst the origin of the other is certainly *non-septic*. The former is shown to be accidental, and in most instances avoidable in open wound complication; whilst the latter has only been observed in connection with the practice of antiseptic surgery. Furthermore, septic fever is only one of a group of symptoms observed in all cases of septic blood-poisoning, while these morbid conditions are properly designated as septicæmia, septo-pyæmia, pyæmia, etc. We, therefore, conclude that the application of the term *traumatic fever* to that morbid condition arising from the absorption of the products of putrefactive decomposition is a misnomer; and it is still an open question whether it ought to be applied to the non-septic fever which was first described by Alfred Genzmer and Richard Volkmann, but which has been recently further discussed by Max Edelberg in an article entitled¹ “Klinischer und experimenteller untersuchungen über das Wundfieber bei der antiseptischen Behandlung.” The latter refers to the differential diagnosis made by Genzmer and Volkmann, and declares that the opinion expressed by them is correct, and, further, that traumatic fever cannot be due to sepsin, as Billroth had supposed, since all the symptoms of septic poisoning are wanting. He has carefully analyzed twenty-four surgical cases which were treated antiseptically; among these were nine who had no fever, while fifteen suffered

¹ Deutsche Zeitschrift für Chirurgie, 1880, s. 62.

from a non-septic traumatic fever; but in the majority of these cases it only lasted one day, and in no case longer than seven. The highest temperature was reached as follows: nine cases on the first day, four cases on the second, two cases on the third; but in a report of twelve cases by V. Wohl, the highest temperature was reached as follows: one case on the first day, six cases on the second, and five cases on the third. The highest temperature, when we include both these reports, which give us a total of twenty-seven cases, was reached as follows: ten cases on the first day, ten cases on the second, and seven cases on the third. The maximum temperature 103.4° , in the twenty-seven cases, was reached on the first day.

My own observations in connection with the practice of antiseptic surgery have been wholly confirmatory of these records, as well as the statements made by Edelberg, Genzmer, and Volkmann in regard to the *non-septic* character of this fever. The increased fever is the only evidence which these cases commonly present of any departure from the ordinary state of health, even after the performance of amputations and other severe cutting operations. It is only in exceptional cases that I have observed the face to be slightly flushed and the pulse a little accelerated, and even in these cases I am unable to recall a single instance where the functions of the body have not been well performed and the patient able to eat, sleep, and enjoy himself. In all cases under my observation the highest temperature has been reached on or before the third day after the operation, and the fever commonly disappears on or before the seventh, if the antiseptic treatment has been strictly adhered to. Edelberg has already called attention to the fact that there is complete absence of all fever in a considerable number of these operations which are treated antiseptically; and, furthermore, that the cases in which this happens are commonly among the less severe major operative procedures.

Unquestionably this statement is confirmed by the experience of most surgeons, and I have before me the complete notes of a case of amputation of the leg through the upper portion of the lower third, which was performed about 8 P. M. September 1, 1879. The highest temperature, 100.2° , occurred on the morning of September 3d. The normal temperature was reached on the morning of September 7th. The average daily temperature until the normal was attained was, in the morning 99.1° , and

in the evening 99.6° . The wound had completely healed, and, therefore, the patient was discharged on October 1st. The pulse never arose higher than 88° during any part of the treatment. The patient remained cheerful during the whole time that he was under my care; ate well, slept well, and actually increased in weight during this month.

Having already presented a few essential points on the subject of the non-septic traumatic fever, together with clinical illustrations of the same, we will now proceed to investigate its etiology. In the performance of this work we are prompted to ask what are the chief factors involved in those injuries and operations which are followed by this fever. We have already incidentally mentioned that the open wound is an essential condition for the development of septic fever, but its relations to non-septic traumatic fever are still to be determined; however, thus far it has only been observed and studied in connection with the practice of antiseptic surgery.

It therefore seems proper to commence our investigation with an inquiry into the effect on the temperature of the various complicating factors of an open wound; and among these may be mentioned shock, loss of blood, the action of carbolic acid, and anæsthetics, especially chloroform and ether. Edelberg has brought before us the views of various authors on the parts performed by some of these factors, and after having experimentally examined them, he gives the conclusions thus reached. Credi has suggested that the traumatic fever following an operation may be explained as a reaction from the lowered temperature associated with the operative procedure. Edelberg in reply calls attention to the fact that, if this opinion is correct, then this fever ought to arise in every case when the temperature has been lowered during the performance of a tedious operation, and, on the contrary, if the operation has been of short duration, and attended with no lowering of temperature, it should be followed by a complete absence of the fever.

Experience has shown, however, that this beautiful theory is not confirmed by practice, and is, therefore, wholly worthless. Edelberg refers to the undecided position of Billroth in regard to the action of chloroform on the temperature, and then proceeds to make three experiments on healthy dogs, by which he shows that the effect of this drug is to lower the temperature without being followed by any reactionary fever. This conclu-

sion is in harmony with the experimental results obtained by Duméril and Demarquay in 1848. He then proceeds to the examination of the opinion expressed by Sonnenberg and Küster, that the fever observed during the antiseptic treatment of wounds is due to the poisonous action of carbolic acid. He cites on this point Hoffmann and Dumion, who find that the administration of this drug produces, after a trifling increase at the commencement, a constant lowering of the temperature, and, he adds as regards carbolic acid producing the fever, all experimenters agree, except Sonnenberg and Küster, that it exerts the opposite effect.

Edelberg also performed numerous experiments on cats and dogs, administering the drug endermically, hypodermically, by the mouth, and by rectal injections. He introduced it into the stomach through a tube in order to avoid unnecessary irritation, and in seven cases he inserted it in pilular form into the rectum. He admits that the introduction of a large quantity of this acid in a concentrated form into the stomach may be followed by a violent gastro-enteritis, and thus cause a rise in the temperature, but denies the possibility of producing this effect unless the drug is employed in such a form as to produce its escharotic action. He furthermore adds that chloroform may be as properly charged with producing fever as carbolic acid. The carefully detailed experiments performed by Edelberg on animals for the purpose of determining the etiology of traumatic fever ought certainly to exclude carbolic acid from all direct agency in it. This experimenter gives little attention to the loss of blood in connection with traumatic fever, but the explanation of what appears to be an omission may be possibly found in the fact, that other works have already shown it to be unimportant in its bearing on wound fever.

It is a well-known and undenied fact that hemorrhage produces a rapid lowering of the temperature, followed under favorable circumstances by a moderate and brief reaction. Pain produces a moderate elevation of the temperature; but neither it, nor the loss of blood, is entitled to much consideration in connection with wound fever. Physical exertion and mental emotions may likewise produce changes in the temperature, but since they are both essentially transient conditions, and with little bearing on our subject, they may consequently be dismissed here without further consideration.

The examination of traumatic fever by Genzmer, Volkmann.

and Edelberg led them to the conclusion that this morbid condition depended on the absorption of some non-septic material from the wounds. These conclusions, and the many interesting facts developed during their investigations, prompted Dr. John Van Vorst, Jr., and myself, to undertake a series of experiments, which have just been completed, in which seventy rabbits were employed, and eight hundred and ninety temperatures taken. These temperatures were all taken with thermometers especially constructed for this purpose, and which, on careful comparison, were found to agree accurately with each other at the various points of the scale, and, furthermore, the instruments were always introduced into the rectum the same distance, and at all times retained there five minutes.

The normal temperature of seventy rabbits, which had not been operated on, was as follows: The maximum, 104.6° ; the minimum, 100° ; average (total), 102.7° ; variation, 4.6° . The normal temperature of forty-three rabbits previously operated on, but which had fully recovered, was as follows: The maximum, 104.4° ; the minimum, 101.3° ; the average (total), 102.9° . The normal average temperature of the one hundred and thirteen rabbits was 102.9° .

The details connected with the etherization of nineteen rabbits are briefly shown in the following: The average temperature prior to the experiment was 102.2° ; the average time required to produce complete anæsthesia by the inhalation of the vapor of ether in the experimental cage was thirty-four minutes, and the average temperature while kept under the anæsthetic influence of this drug was as follows: One-half hour, 101.1° ; one hour, 101.4° ; one hour and a half, 102° ; and two hours, 101.7° . It should be observed that these rabbits were kept continuously under the anæsthetic influence of the drug two hours, during which period the temperature was taken every half hour, and at the expiration of this time they were removed from the experimental cage and placed in the fresh air, where they soon regained their former condition, and the temperature was now noted on three consecutive days, care being taken to preserve an interval of twenty-four hours between each record, with the following results: First day 102.6° , second day 102.2° , third day 102.3° .

It will be seen by the above figures, that the first half hour that the rabbits were kept under the influence of the ether the

average temperature was lowered one and one-tenth degree; however during the succeeding hour the temperature arose to within two-tenths of a degree of what it was before the experiment began; but during the next half hour fell three-tenths of a degree. The daily temperature indicates only a trifling and wholly unimportant reaction.

The following are the essential facts connected with the anæsthetic administration of chloroform to twenty-two rabbits: The average temperature before the experiment was 102.8° . The average time required to produce complete anæsthesia was twenty-six and a half minutes, and the average temperature while kept under the influence of chloroform was as follows: One-half hour 100.7° , one hour 101.4° , one hour and a half 101.2° , and at the expiration of the two hours 101.5° . The same care was taken in making the daily records after the administration of chloroform as had been observed when the ether was employed. The daily record of the average temperature was, on first day 101.8° , second day 101.9° , and on the third day 101.8° . The rapid fall of temperature during the first half hour that the rabbits were under the influence of the ether was a marked feature of this experiment, but it will be observed that this primary effect almost wholly disappeared during the next hour, although the anæsthetic influence of the drug was continued. The depressing effects of chloroform as an anæsthetic are still more marked, and we observe at the end of the first half hour, that the average temperature had been lowered two degrees and one-tenth instead of one and one-tenth. Furthermore, we observe that the reaction during the administration of chloroform is much less than when ether was employed. Even the normal average temperature had not been reached after the lapse of three days. The next condition investigated was that which is commonly designated as shock, since it frequently forms a complication in cases of wounds and severe operations. The object which we sought to accomplish by this investigation was a determination of the question, is shock followed by a reactionary fever? It will be readily admitted that shock as a complication of a wound or operation is too intimately associated with the traumatism to be conveniently studied. We, therefore, sought in this case to produce shock without causing at the same time any organic lesion. We employed for this purpose a galvanic battery, and readily produced the desired effect by introducing one pole in the

mouth, while the other was in the rectum. It should be mentioned that the severity of the shock varied considerably, however none of the animals were able to run or even walk well after receiving their allotment, and one was observed to lie on his side, where he had been placed, more than five minutes, gasping at long intervals before he was able to raise his head. The result of this experiment may be summed up as follows: Nineteen rabbits employed; average temperature before shock 102.8° ; average temperature within two hours 102.8° ; average temperature within eighteen hours 102.8° ; and the average temperature within thirty hours 102.8° . It may now be stated that the result of this experiment, so far as the production of any reactionary fever by shock is concerned, demonstrates a negative.

The next experiment which we will report consisted in fracturing the right leg of twenty rabbits. This was done without producing a single compound fracture. The temperature details are as follows: average temperature before the fracture, 102.6° ; average temperature two hours afterwards, 102.6° ; subsequent daily average temperature: first 102.6° , second 102.6° , third 103.1° , fourth 103.1° , sixth 103° , eighth 103.1° , tenth 102.8° , twelfth 103° , fifteenth, 102.8° , seventeenth 103.2° , nineteenth 103° , twenty-second 103° . It is shown by the above figures that the highest average temperature occurred on the seventeenth day. The temperature on this day was found to be six-tenths of a degree higher than that recorded immediately before the fractures were produced. A small number of the fractures which were originally simple became compound during the period that the rabbits were under observation. As soon as any wound was discovered on the rabbits, whether in connection with the fracture or elsewhere, the temperature was no longer recorded, since it was our object here to avoid all septic complications. On the twenty-second day after the fractures were produced, there was found to be pretty firm union.

In the final experiment ten rabbits were employed, and the operation consisted in injecting into each, beneath the integument in the lateral lumbar region, one-half ounce of arterial blood. This blood in one instance only was taken from one rabbit and injected into another; but in nine cases the blood was obtained from a dog. We regarded it as very desirable to accomplish this part of the operation with the least possible exposure to the air, and at the same time to preserve essentially

the normal temperature of the blood. We employed Fryer's transfusion apparatus, and the details of the operative procedure were as follows: The dog having been anaesthetized, an incision was made down to the right common carotid, which was raised from its bed, and the handle of a scalpel placed beneath it, the proper canula was introduced and secured in this vessel; the tube and bulbs had been previously filled with hot water, and the other end of the instrument supplied with an aspirator needle instead of the ordinary canula; the hair had been closely cut with scissors at the place where the needle was intended to be entered, the needle was passed through the centre of a sponge, which had been previously soaked and was still wet with a carbolic acid solution; the stopcocks were now opened, the hot water was quickly discharged, closely followed by the blood; the stopcocks were again closed and the sponge quickly slipped down over the opening in the end of the needle; the rabbit's skin, having been cleansed at the spot where the injection was to be made, was now moistened with the sponge covering the point of the needle; this sponge was then pushed back, the needle entered beneath the integument, the injection made, stopcock closed, needle withdrawn and its aperture closed as previously described. In this manner the work proceeded until the whole number had been injected. The following figures indicate the slight fluctuations in the temperature observed in connection with this experiment. The average temperature before the injection was 103.2° ; average temperature three hours after, 103.2° ; average temperature one day after, 103.3° ; and it was subsequently as follows: second day 103° , third day 102.8° , fourth day 103.3° , fifth day 103.2° , and the eighth 103.2° .

The relatively large quantity of blood which was thrown into the cellular tissue in this experiment produced no perceptible effect on the temperature, as the fluctuations already noticed are not only within the limits of the normal variations, but are really so slight as to possess only negative value. The one-half ounce of blood injected into the rabbit bears about the same relation to the whole weight of the animal as twenty ounces would to one hundred and sixty pounds. This experiment would, therefore, seem to justify the conclusion that the absorption of a large quantity of blood produces very little or *even no effect on the temperature*. Furthermore, it may be added that the blood was all absorbed from these tumors within a few days, which had been

produced by the injections; and that without causing any local or constitutional disturbance, with only a single exception. In the exceptional case the tumor failed to disappear, and after the discontinuance of the temperature observations an abscess formed which opened, and the rabbit finally died from septic poisoning.

We have now presented separately the results of our experimental inquiry into the etiology of traumatic fever. This investigation was commenced for the purpose of determining, as far as possible, the effects on the temperature of the various factors which primarily complicate wounds and surgical operations, and we have consequently endeavored to avoid any coalition which could lead to septic complications. We are now convinced that the fever observed in connection with the antiseptically treated wounds does not owe its origin directly to the lesion, or its usual complications. Does it arise from the absorption of carbolic acid? Edelberg, who has carefully investigated this subject, gives us a negative answer; and we think that those who take the trouble to follow him studiously through his experiments will finally accept his conclusion.

This important question, what causes the *non-septic* fever, still remains unanswered. Genzmer and Volkmann have supposed that it originated in absorption from the wound, but do not designate the substance thus taken up. Another author, V. Wohl, has suggested that there may be a connection between the blood contained in the wound and the traumatic fever. Edelberg remarks on this subject, that should it really be proved that such a connection exists, then it is evident that this relation could only be by the means of a fibrine-ferment. He further adds: I have made, under the friendly direction of Prof. Alexander Schmidt, here in the physiological institute, a large number of experiments with fibrine-ferment, the results of which I will publish *in extenso* in another place; as they are pathologically more interesting, whilst here I must be content to state the conclusions drawn from them.

The essential points contained in these conclusions are as follows: The fibrine-ferment in a certain quantity produces death by the coagulation of the blood; in a smaller quantity it gives rise to complex symptoms with a considerable rise of temperature—the latter being characteristic of the action of fibrine-ferment; and furthermore, the same class of symptoms may be pro-

duced by the injection of the watery extract of the blood, which does not contain any free fibrine-ferment. The result of these experiments led him to infer that the cause of the traumatic fever observed in connection with the antiseptic treatment of wounds should be sought for in the partly coagulated and partly fluid blood, instead of the carbolic acid.

In support of this position he offers these arguments. This view finds its best support in the character of the wound fever. Why do we see the temperature rise very rapidly after an injury, and usually reach its maximum on the first day, where there can be no question of suppuration and septic action, whilst, on the contrary, clinical observation shows that there is in the wound only blood or a bloody-colored secretion? He now brings forward in support of this hypothesis several typical cases of traumatic fever, in which there was found the characteristic condition of the wound which has been previously described, and also other cases in which the absence of the coagulated blood and the bloody serum was further marked by a complete absence of fever. He remarks it would certainly carry me too far, if I should discuss from this standpoint all the cases which I have observed, and which seem to justify me in asserting, that traumatic fever may be properly regarded as an *absorption fever*, and indeed only as an *absorption fever*, produced by the absorption of blood (fibrine-ferment) from the wound. He further adds: Now, if this inference is correct, there must arise a similar fever in cases of simple fractures of the extremities associated with an extravasation of blood, and, in fact, practice rarely corroborates theory so completely as in these cases. Every surgeon has certainly had opportunities to observe that simple fracture, if associated with a more or less marked extravasation of blood, is also embarrassed by a high temperature. But to what ought the fever to be attributed? Should it not be regarded essentially as an absorption fever? I believe one will not be far from the truth if he answers this question affirmatively.

Having outlined as briefly as possible the experiments, arguments, and conclusions of Edelberg, whose publication gave rise to our experimental inquiry, although our clinical observations are of a much older date, we are prepared to express the results of our study so far as our investigations may warrant it. Let us now consider the question, does traumatic fever arise from the absorption of subcutaneously extravasated blood? The ex-

periment we made by injecting blood into cellular tissue beneath the integument gives *to this question a negative answer*, and our own observation in surgical practice is confirmatory of the same. I can now recall to mind numerous cases of bloody tumors, and subcutaneous blood extravasations, in which the absorption never gave rise to any fevers. *In fact, these conditions are characterized by a complete absence of all fever, and the existence of fracture in connection with the extravasation does not change the rule.* We are therefore constrained by clinical observation and experimental inquiry to deny that traumatic fever has its origin in the absorption of subcutaneously extravasated blood; and furthermore, while admitting its existence and peculiarities as described by Genzmer and Volkmann, we are firmly convinced that *it is never seen in the practice of antiseptic surgery.*

Edelberg has satisfactorily shown that this fever does not arise directly from the carbolic acid, or from chemical or physiological changes produced by the same in the tissues and fluids of the body, so long as they remain in their normal and healthy state and are not exposed to the air. He attributes this fever to the presence of fibrine-ferment, or some similar substance which has been absorbed from the wounds, and which were primarily developed from the wound secretion, but gives us no information in regard to the agencies by which it was produced. The experimental and clinical research has probably already been sufficient to justify the exclusion of the majority of the wound complications from any active agency in the production of traumatic fever; and we are led by our own investigation to believe that the cause of this fever should now be sought for in the action of the carbolic acid on the wound secretion aided by the air; while the absorption of the new product is unquestionably the first step in the development of the morbid condition.







